

Potential Transport of Harmful Algae through Relocation of Bivalve Molluscs

Author(s): Helene Hegaret¹, Sandra Shumway¹, Gary Wikfors², Susan Pate³, JoAnn Burkholder³

Affiliation(s): ¹Department of Marine Sciences, University of Connecticut; ²Northeast Fisheries Science Center - National Marine Fisheries Service (NMFS) - National Oceanic and Atmospheric Administration (NOAA); ³North Carolina State University, Department of Botany.

ABSTRACT:

Aquaculture and restoration activities with bivalve molluscs often include moving individuals from one body of water to another. Our study tests the hypothesis that harmful algae ingested by source populations of shellfish can be introduced into new environments by means of these shellfish relocations. Cultures of several harmful algal strains, including *Prorocentrum minimum*, *Alexandrium fundyense*, *Heterosigma akashiwo*, *Aureococcus anophagefferens*, *Gymnodinium mikimotoi*, and *Alexandrium moniliforme*, were fed to various species of bivalve molluscs, including *Crassostrea virginica*, *Argopecten irradians irradians*, *Mercenaria mercenaria*, *Mytilus edulis*, *Mya arenaria*, *Venerupis philippinarum*, and *Perna viridis*, to assess the ability of the algal cells to pass intact through the digestive tracts of the shellfish and subsequently grow. Ten individuals of each shellfish species were exposed for two days to a simulated harmful algal bloom at a natural bloom concentration. The shellfish were removed after two days of exposure and kept for two more days in ultrafiltered seawater. Feces and pseudofeces were collected after 24 and 48 additional hours and observed under the microscope for the presence or absence of intact, potentially viable cells or temporary cysts of the algae. Subsamples of biodeposits were transferred into both algal culture medium and filtered seawater (FSW) and monitored microscopically for algal growth. Intact cells of most harmful algal species tested were seen in biodeposits. Generally, harmful algae from the biodeposits collected in the first 24 hours after transfer re-established growing populations, but algae were less often able to recover from the biodeposits collected after 48 hours. These data provide evidence that transplanted bivalve molluscs may be vectors for the transport of harmful algae and that a short period of "depuration" may mitigate this risk. Further, preliminary results indicate that emersion may also serve to mitigate the risk of transport.

GOAL:

Pursue an easy and inexpensive way to prevent the transfer of harmful algae through transport of bivalves from one area to another.

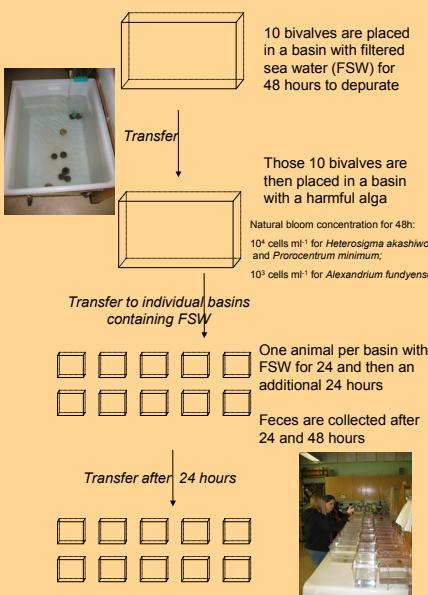
QUESTIONS:

Can harmful algae pass as intact, viable cells through the digestive systems of bivalves?

Can the harmful algae present in the feces recover when cultured in filtered seawater (FSW) or in media?

Can a transplanted bivalve be a vector co-transporting harmful algae?

PROTOCOL: 1-WEEK EXPERIMENT



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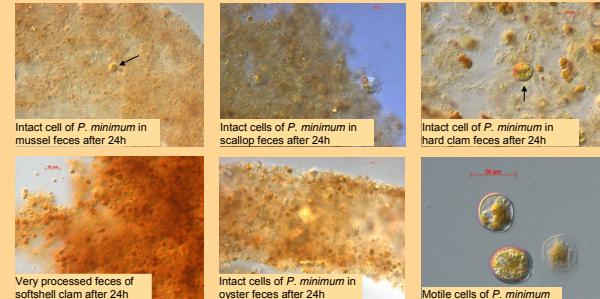
PRESENCE OF INTACT HAB CELLS IN THE FECES

Intact cells of harmful algae could be observed in fecal pellets after 24 or 48 hours of depuration in FSW (light and epifluorescence photomicrographs):

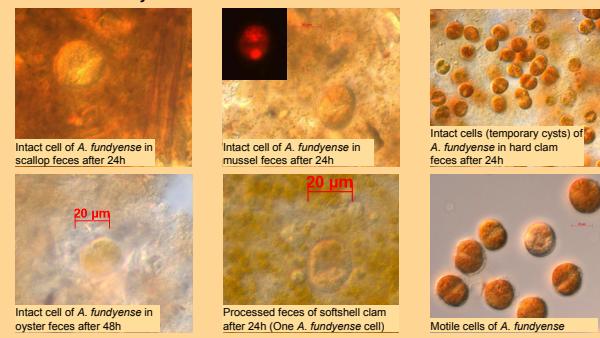
Heterosigma akashiwo



Prorocentrum minimum



Alexandrium fundyense



Pfiesteria piscicida and *P. shumwayae* (Springer et al. 2002, MEPS, 245 : 1-10; Shumway et al. submitted), *Alexandrium moniliforme* (Pate, 2006), *Alexandrium fundyense*, *Heterosigma akashiwo* and *Prorocentrum minimum* have all been seen as intact cells in biodeposits.

No intact cells in the biodeposits of the softshell clam, *Mya arenaria* were observed after 24 or 48 hours of depuration. Their feces always appeared thoroughly processed.

CONCLUSIONS:

These data show the potential for transplanted bivalves to be vectors for transport of harmful algae.

HAB cells were usually observed intact in the feces of bivalves, and growing populations were re-established from feces when cultured in FSW the first 24 hours, but generally not after 24 hours of depuration.

This risk of introducing an HAB while moving shellfish is widespread among the bivalve-HAB combinations tested, though not identical for all combinations, and accordingly needs to be considered in management, restoration, and aquaculture activities for which shellfish are transplanted.

Mitigation of the risk of HAB transport by a 24-hr depuration period in seawater is promising, but needs development and practical trials before a final protocol can be recommended.

RECOVERY OF HAB CELLS IN THE FECES

We inoculated both media in which the cells were grown and filtered seawater with feces collected from each individual bivalve

Culture tubes were maintained on 12h/12h light/dark cycle

Check for growth of HAB cells in the tubes

	After 24-hr depuration				
	<i>Alexandrium</i>	<i>fundyense</i>	<i>Prorocentrum</i>	<i>minimum</i>	<i>Heterosigma</i>
<i>Mercenaria mercenaria</i>	+	+	+		
<i>Mya arenaria</i>	-	-	-		
<i>Crassostrea virginica</i>	+	+	no feces		
<i>Argopecten irradians</i>	+	+	+		
<i>Mytilus edulis</i>	+	+	-		

After 48-hr depuration

	<i>Alexandrium</i>	<i>fundyense</i>	<i>Prorocentrum</i>	<i>minimum</i>	<i>Heterosigma</i>	<i>akashiwo</i>
<i>Mercenaria mercenaria</i>	-	-	-	-	-	-
<i>Mya arenaria</i>	-	-	-	-	-	-
<i>Crassostrea virginica</i>	-	-	-	-	-	+
<i>Argopecten irradians</i>	-	-	-	-	-	+
<i>Mytilus edulis</i>	-	-	-	-	-	-

Growing populations were re-established from feces when cultured in FSW, usually not in the growth media, in the first 24 hours, but generally not after 24 hours of depuration.

Not a single cell was observed to recover from the biodeposits of the softshell clam, *Mya arenaria*, after 24 or 48 hours.

SPREADING SHELLFISH AND ???



EcoHAB Ecology and Oceanography of Harmful Algal Blooms

Through EPA's partnership in the interagency ECOHAB program, NCER (The National Center for Environmental Research) sponsors research in support of the development of detection, control, and mitigation technologies for HABs, that directly complements the Agency's mission.



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